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(54) Scanning control system for an ion-implantation apparatus.

(57) The invention provides a novel scanning control system of preventing any over-scanning involved in an ion-implantation apparatus accomplishing an electrostatic X-scanning and a mechanical Y-scanning. The system includes a liner detecting arrangement (6) for detecting over-scanning comprising a horizontal and sequential alignment of plural Faraday tubes. The detecting arrangement (6) having a larger length than a diameter of a wafer (1) is located behind the wafer (1) mounted on a platen (2). The system also includes an X-scanning width control feature (7) which is electrically connected to the detecting arrangement (6) to fetch results of over-scanning detection. The X-scanning width control feature (7) is determinative of a frequency of X-scanning associated with a width of X-scanning and supplies X-scanning frequency control voltage signals to X-deflector electrode plates (4) making a pair thereby preventing over-scanning. The system further includes a Y-scanning speed control feature (3, 8) for controlling a speed of Y-direction movement of the wafer according to the frequency of the X-scanning thereby securing an uniformity of ion-implantation to the wafer.

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The invention relates to an ion-implantation apparatus of a sheet type, and more particularly to an ion-beam scanning control feature involved in an ion-implantation apparatus of a parallel scanning type which accomplishes electrostatic X-scanning of ion-beam and mechanical Y-scanning.

In general, the sheet type ion-implantation apparatus has been used for accomplishment of ion-implantation in a medium current region. Such sheet type ion-implantation apparatus may be divided into following two types. One is an electrostatic scanning type ion-implantation apparatus which accomplishes X-electrostatic scanning and Y-electrostatic scanning of ion-beams at predetermined frequencies respectively. Another is a parallel scanning type ion-implantation apparatus which accomplishes X-electrostatic scanning of the ion-beam and mechanical Y-scanning at predetermined frequencies respectively.

In the prior art, such parallel scanning type of ion-implantation apparatus has following structures. With reference to FIG. 1, the conventional structure of the ion-beam scanning control feature involved in the parallel scanning type ion-implantation apparatus has a platen 2 on which a wafer 1 is provided. The platen 2 is supported by a Y-scanning feature 3 so as to be movable in the vertical direction, or Y-direction thereby accomplishing the mechanical Y-scanning in the vertical direction. In contrast to such mechanical scanning of the Y-scanning, an X-scanning of the ion-beam 5 in the horizontal direction is accomplished by the electrostatic scanning which employs a pair of X-deflector electrode plates 4 at a predetermined frequency, typically 500Hz. Further, such conventional structure of the ion-beam scanning control feature includes two Faraday tubes 6 serving as detecting elements, both of which are arranged at diametrically opposite sides approximately and behind the platen 2. The Faraday tubes 6 are so supported as to be in separation from the platen 2 which is movable in the vertical direction. Such Faraday tubes 6 serve to catch the ion-beam and makes a measurement of a current generated by the ion-beam 5.

The operation of the ion-beam scanning control feature involved in the parallel scanning type ion-implantation apparatus will subsequently be described with reference to FIG. 1. The ion-beam 5 is transmitted through a space sandwiched by a pair of the X-deflector electrode plates 4 to the wafer 1 provided on the platen 2. The ions having a predetermined energy in average supplied by the ion-beam 5 are implanted into the wafer 1. The X-scanning of the ion-beam 5 has a predetermined frequency which is controlled by voltage signals applied to the X-deflector electrode plates 4. The Y-scanning feature 3 moves the platen 2 on which the wafer 1 is provided in the Y-direction, or vertical direction thereby accomplishing the mechanical Y-scanning.

The problem with such X-scanning of the ion-beam 5 is an over-scanning which provides unnecessary ion-beams to which an external area and thus an opposite area to the surface of the wafer 1 is subjected. To prevent such over-scanning, the conventional apparatus includes a detecting feature of the over scanning. In the X-scanning accomplished by a pair of the X-deflector electrode plates 4, if any over-scanning of the ion-beam 5, which has a larger scanning width than the diameter of the wafer 1, occurs, the Faraday tubes 6 catches the over-scanning ion-beams thereby the Faraday tubes 6 renders the detection of the over-scanning. When the over-scanning of the ion-beam 5 is detected by the Faraday tubes 6, a pair of the X-deflector electrode plates 4 is applied with voltage signals which provide a predetermined scanning frequency. The scanning frequency provided by such X-deflector electrode plates 4 is determinative of the scanning width of the ion-beam 5 in the X-direction, or the horizontal direction so as to limit the scanning width of the ion-beam 5 to the diameter of the wafer 1 provided on the platen 2. As a result of those, such scanning ion-beam 5 has an uniformity in the X-scanning width which is defined by the distance between the two Faraday tubes 6.

Although the wafer 1 is shaped into a circular, such scanning area of the ion-beam 5 is defined into a square to which the circular defined by the wafer 1 is touched internally. Since the wafer 1 which is subjected to the ion-implantation is shaped into a circular, such conventional ion-beam scanning having the uniformity in the X-scanning width and thus having a square ion-implantation area is forced to have an unnecessary scanning such as over-scanning to which such square area except for the circular shaped wafer 1 is subjected. Then, four corner areas in the square ion-implantation area except for an overlapping area to the wafer is subjected to the over-scanning of the ion-beam. It is, therefore, required to develop a novel scanning control feature which is free from any over-scanning, or unnecessary scanning. Further, such over-scanning to the external area to the wafer requires any unnecessary times for an ion-implantation process. It is, thus, considerable to prevent any over-scanning.

Accordingly, it is a primary object of the present invention to provide a novel scanning control feature involved in an ion-implantation apparatus.

It is a further object of the present invention to provide a novel scanning control feature involved in an ion-implantation apparatus, which permits preventing an unnecessary scanning, or a over-scanning of ion-beam.

It is a still further object of the present invention to provide a novel control feature of an electrostatic X-scanning involved in an ion-implantation apparatus, which permits preventing an unnecessary scanning, or a over-scanning of ion-beam.

It is yet a further object of the present invention

to provide a novel control feature of an electrostatic X-scanning involved in an ion-implantation apparatus, which permits providing a substantial time reduction of the ion-implantation to a wafer.

The above and other objects, features and advantages of the present invention will be apparent from following descriptions.

The present invention provides a scanning control system for an ion-implantation apparatus employing mechanical scanning of an ion beam across a target in a first axis direction and ion-beam deflection scanning in a second axis direction orthogonal to the first axis. and having means for mounting a target, said mounting means being movable in the first axis direction to provide said mechanical scanning; characterised in that the scanning control system comprises means locatable behind said mounting means for detecting over-scanning of the ion-beam. said detecting means extending in the second axis direction over a length larger than the maximum dimension of said target in the second axis direction; and means electrically connected to said detecting means for controlling the scanning amplitude of the ion-beam in the second axis direction in response to over-scanning detected by the detecting means.

The invention also provides a novel scanning control system in an ion-implantation apparatus which accomplishes an electrostatic X-scanning and a mechanical Y-scanning. The novel scanning control system includes a platen which mounts a wafer to be subjected to ion-implantation. The platen mounting the wafer is supported by a Y-scanning feature so as to be movable in a Y-direction.

The novel scanning control system also includes an improved detecting arrangement which makes a detection of over-scanning of ion-beam to which an external area and thus opposite area to the wafer is subjected. The detecting arrangement essentially comprises a line segment having a larger width than a diameter of the wafer. The detecting arrangement is located behind the wafer at the same level position as an ion-beam level position. For example, the detecting arrangement may comprise a horizontal and sequential alignment of a plurality of detecting elements such as Faraday tubes. The detecting elements such as the Faraday tubes make a measurement of a current generated by over-scanning ion-beam.

The novel scanning control system also includes an X-scanning width control feature for controlling an X-scanning width of ion-beam. The X-scanning width control feature is electrically connected to the detecting arrangement such as the alignment of Faraday tubes so as to fetch results of the over-scanning detection as electrical signals from the detecting arrangement. The X-scanning width control feature is determinative of a frequency of X-scanning of ion-beam according to the fetched results of the over-scanning detection. The X-scanning width is associated with the frequency of the X-scanning due to a constant X-scanning speed. The X-scanning width control feature supplies X-deflector electrode plates with frequency control voltage signals which are determinative of the frequency of the X-scanning of ion-beam, and thus the width of the X-scanning. As a result of those, the X-scanning width is always controlled to correspond to a horizontal length of a portion of the circular shaped wafer which is subjected to ion-beam, although the wafer is moved in the Y-direction due to accomplishment of the mechanical Y-scanning.

The novel scanning control system further includes a Y-scanning speed control feature for controlling a speed of Y-direction movement of the wafer mounted on the platen. The Y-scanning speed control feature is electrically connected to the X-scanning width control feature so as to receive informations of the frequency of the X-scanning of ion-beam. The Y-scanning speed control feature is determinative of the Y-scanning speed according to the in formations of the frequency of the X-scanning and supplies Y-scanning speed control signals to the Y-scanning features which supports the platen mounting the wafer. The Y-scanning feature receives the Y-scanning speed control signals and controls the Y-scanning speed thereby providing a desirable ion-implantation having an uniformity in a dopant concentration.

The invention also includes ion-implantation apparatus with a scanning control system as set forth above.

Preferred embodiments of the present invention will hereinafter be described in detail with reference to the accompanying drawings.

FIG. 1 is a schematic and perspective view illustrative of a structure of the conventional scanning control feature of ion beams involved in the ion-implantation apparatus.

FIG. 2 is a schematic and perspective view illustrative of a structure of a novel scanning control feature of ion-beams involved in an ion-implantation apparatus.

The present invention provides an improved parallel scanning type ion-implantation apparatus. in which an X-scanning in the horizontal direction is accomplished by an electrostatic scanning and a Y-scanning in the vertical direction is accomplished by a mechanical scanning. Further, the present invention essentially provides a novel control feature of the electrostatic X-scanning involved in the parallel scanning type ion-implantation apparatus, which permits preventing unnecessary scanning, or over-scanning of an ion-beam 5. A preferred embodiment of the present invention will now be described in detail with reference to FIG. 2.

An improved parallel scanning type ion-implantation apparatus includes a novel ion-beam scanning

control feature. The structure of the novel ion-beam scanning control feature has a platen 2 on which a wafer 1 is provided. The platen 2 is supported by a Y-scanning feature 3 so as to be movable in the vertical direction, or Y-direction thereby accomplishing the mechanical Y-scanning in the vertical direction. In contrast to such mechanical Y-scanning, an X-scanning of the ion-beam 5 in the horizontal direction is accomplished by the electrostatic scanning which employs a pair of X-deflector electrode plates 4. The ion-beam 5 is transmitted to the surface of the wafer 1 provided on the platen 2 through a space between the X-deflector electrode plates 4 making a pair. The X-deflector electrode plates 4 are applied with voltage signals which is determinative of and controls a frequency of the X-scanning of the ion-beam 5. Such electrostatic X-scanning of the ion-beam 5 is also accomplished at a predetermined frequency.

Further, such novel structure of the ion-beam scanning control feature includes a detecting arrangement which is shaped into a horizontal line segment. The detecting arrangement is detective of the ion-beam, for instance, makes a measurement of a current generated by the ion-beam 5. Such detecting arrangement may comprises a horizontal and sequential alignment of a plurality of Faraday tubes 6, each of which serves as a detecting element for the ion-beam 5. Each of the plural Faraday tubes 6 catches the ion-beam 5 and makes a measurement of a current generated by the ion-beam 5. In this embodiment, seventeen Faraday tubes 6 are used to form the detecting arrangement of the line segment, although it is by all means required to do so. Then, the number of the Faraday tubes 6 is variable.

Such detecting arrangement comprising the horizontal and sequential alignment of the seventeen Faraday tubes 6 is located behind the platen 1 including the wafer 1. Such detecting arrangement comprising the horizontal and sequential alignment of the seventeen Faraday tubes 6 also has a predetermined length which is larger than the diameter of the circular shaped wafer 1. As a result of those, at least opposite terminal Faraday tubes 6 involved in the alignment of the seventeen Faraday tubes 6 always exist at an outside of the platen 2 including the wafer 1 at any positions of the platen 2 in the Y-direction, or the vertical direction. The detecting arrangement comprising the horizontal and sequential alignment of the seventeen Faraday tubes 6 are supported at the same level position as a level position of the ion-beam 5, the scanning of which is the horizontal scanning only. The vertical scanning, or the Y-scanning is accomplished by vertically moving the platen 2 including the wafer 1. Thus, the detecting arrangement comprising the horizontal and sequential alignment of the seventeen Faraday tubes 6 is so supported as to be separated from the platen 2 including the wafer 1 which is movable in the vertical direction.

In addition, such novel structure of the ion-beam scanning control feature includes an X-scanning width control feature 7 which is electrically connected to the detecting arrangement comprising the horizontal and sequential alignment of the seventeen Faraday tubes 6. The X-scanning width control feature 7 fetches any detected results as electrical signals from the detecting arrangement comprising the alignment of the plural Faraday tubes 6. The X-scanning width control feature 7 is also electrically connected to each of the X-deflector electrode plates 4. The X-scanning width control feature 7 supplies X-scanning width control voltage signals to the X-deflector electrode plates 4 in accordance with the electrical signals serving as the detected results fetched from the detecting arrangement comprising the alignment of the plural Faraday tubes 6. The X-scanning width control voltage signals applied to the X-deflector plates 4 is determinative of a preferable frequency of the X-scanning of the ion-beam 5 which is transmitted in approximately parallel to and though the space between the X-deflector electrode plates 4.

Furthermore, such novel structure of the ion-beam scanning control feature includes a Y-scanning speed control feature 8 which is electrically connected to the X-scanning width control feature 7. The Y-scanning speed control feature 8 receives any electrical signals from the X-scanning width control feature 7. The Y-scanning speed control feature 8 is also electrically connected to the Y-scanning feature which supports and moves the platen 2 including the wafer 1 in the vertical direction. As the above described, the X-scanning width control feature 7 supplies the X-deflector electrode plates 4 with X-scanning width control voltage signals which is determinative of and controls the frequency of the X-scanning of the ion-beam 5. Concurrently, the X-scanning width control feature 7 supplies the X-scanning width control voltage signals to the Y-scanning speed control feature 8. Thus, the Y-scanning speed control feature 8 supplies Y-scanning speed control electrical signals to the Y-scanning feature 3 in accordance with the X-scanning width control voltage signals fetched from the X-scanning width control feature 7. In consequence of those, the Y-scanning speed control electrical signals are determinative of and controls the Y-scanning speed in association with the frequency of the X-scanning of the ion-beam 5 which is determined and controlled by the X-scanning width control voltage signals.

The operation of the novel ion-beam scanning control feature in the parallel scanning type ion-implantation apparatus will subsequently be described.

In the improved parallel scanning type ion-implantation apparatus, the mechanical Y-scanning in the vertical direction is accomplished with using the Y-scanning feature which vertically movies the platen 2 including the wafer 1. In contrast to the mechanical

Y-scanning, the X-scanning in the horizontal direction is accomplished by the electrostatic scanning of the ion-beam 5. The scanning of the ion-beam 5 has the X-component only. The ion-beam is transmitted to the surface of the wafer 1 provided on the platen 2 trough the space between the X-deflector electrode plates 4. The X-deflector electrode plates 4 are applied with the X-scanning width control voltage signals which cause an alternating electric field at the space between the X-deflector electrode plates 4. The ion-beam 4 is transmitted in perpendicular to the direction of the electric field, and thus in parallel to the X-deflector electrode plates 4. The frequency of the electric field generated between the X-deflector electrode plates 4 is determinative of the frequency of the X-scanning of the ion-beam 5. The frequency of the X-scanning of the ion-beam 5 which is determinative of the width of the X-scanning of the ion-beams 5. Thus, the frequency and the width of the X-scanning of the ion-beam 5 is defined by the X-scanning width control voltage signals applied to the X-deflector electrode plates 4. It is desirable to prevent any unnecessary ion-beam scanning to which an external area, and thus an opposite area to the wafer 1 is subjected. The implementation of a desirable ion-implantation without unnecessary ion-beam scanning requires the novel scanning control feature to precisely and speedy control the frequency and the width of the X-scanning in association with the vertical position of the platen 2 including the wafer 1.

Since the wafer 1 is shaped into a circular, the horizontal length of the wafer 1 is variable in dependence upon the vertical position, or the Y-position. It is, thus, required that the X-scanning width of ion-beam 5, which depends upon the frequency is so controlled as to correspond to the horizontal length of the wafer 1 in accordance with the Y-position, or the vertical position of the platen 2 including the wafer 1.

When the platen 2 including the wafer 1 exists at a Y-position , a horizontal length which is in the same level as the ion-beam X-scanning level of the wafer 1 is defined. Any normal X-scanning makes the circular shaped wafer 1 be subjected to the ion-beam 5. If any over-scanning, to which the external area, and thus the opposite area to the wafer 1 is subjected, occurs, the ion-beam 5 is caught and detected by the detecting arrangement comprising the horizontal and sequential alignment of the plural Faraday tubes 6. For example, any Faraday tubes 6 catch the ion-beam 5 and make a measurement of a current generated by the ion-beam 5 thereby detecting such over-scanning. It is required to promptly suppress such over-scanning.

The detecting arrangement comprising the horizontal and sequential alignment of the plural Faraday tubes 6 transmits the detecting results concerning the over-scanning of the ion-beam 5 as electrical signals to the X-scanning width control signal feature 7. The X-scanning width control feature 7 fetches the result of the detection of the ion-beam over-scanning as the electrical signals from the detecting arrangement comprising the horizontal and sequential alignment of the plural Faraday tubes 6. The X-scanning width control feature 7 supplies X-scanning width control voltage signals to the X-deflector electrode plates 4 in accordance with the electrical signals serving as the detected results of the over-scanning of the ion-beam 5. The X-scanning width control voltage signals applied to the X-deflector plates 4 is determinative of a preferable frequency of the X-scanning of the ion-beam 5 which provides a suitable X-scanning width corresponding to the horizontal length of the wafer 1 at the same level as the scanning ion-beam. When the X-scanning width of the ion-beam 5 is so controlled as to correspond the horizontal length of the wafer 1, the detecting arrangement comprising the alignment of the plural Faraday tubes 6 is no longer able to catch the ion-beam 5, and thus to make the detection of the over-scanning of the ion-beam 5. In this case, all of the scanning ion-beam 5 is applied to the wafer 1. Consequently, the detecting arrangement makes a measurement of zero current produced by the ion-beam 5.

Further, the ion-implantation to the wafer 1 is required to have an uniformity in a dopant concentration. The realization of those requires the Y-scanning feature 3 supporting the platen 2 including the wafer 1 to control the Y-scanning speed in association with the frequency of the X-scanning. Preferably, the X-scanning speed remains at a predetermined value in order to realize the ion-implantation to the wafer 1 having an uniformity of the dopant concentration. The uniformity of the ion-implantation to the wafer 1 is accomplished by controlling the mechanical Y-scanning speed which is provided by the vertical movement of the wafer 1. In general, as the horizontal length of the wafer 1 which is subjected to the ion-beam 5 is short, the width of the X-scanning is controlled to be short so that the width of the X-scanning corresponds to the horizontal length of the wafer 1. As the width of the X-scanning is short, the frequency of the X-scanning is forced to be high due to a constant X-scanning speed. The high frequency X-scanning requires a high Y-scanning speed provided by the Y-scanning feature 3 in order to secure the uniformity of the ion-implantation to the wafer 1. It is, therefore, required that the Y-scanning speed is controlled depending upon the frequency of the ion-beam X-scanning which is defined by the X-scanning width control signals.

The X-scanning width control feature 7 supplies the X-scanning width control voltage signals to not only the X-deflector electrode plates 4 but the Y-scanning speed control feature 8. The Y-scanning speed control feature 8 receives the X-scanning width control voltage signals and determines a prefer-

able Y-scanning speed in accordance with the X-scanning width, and thus the frequency of the ion-beam X-scanning which is determined according to the Y-position of the wafer 1. The Y-scanning speed control feature 8 supplies the Y-scanning feature 3 with Y-scanning speed control signals which provides the preferable Y-scanning speed. The Y-scanning feature 3 receives the Y-scanning speed control signals and moves vertically the platen 2 including the wafer 1 at a preferable speed according to the Y-scanning speed control signals thereby securing the uniformity of the ion-implantation to the wafer 1.

Such vertical movement of the wafer 1 provided by the Y-scanning feature 3 makes the vertical position of the wafer 1 be varied. The portion of the wafer 1 which is subjected to the ion-beam 5 is also varied with the vertical movement of the wafer 1. Consequently, the horizontal length of the portion of the wafer 1 which is subjected to the ion-beam 5 is varied. Then, the width of the X-scanning is so controlled as to correspond to the horizontal length of the wafer 1 by the X-scanning width control feature 7. The control mechanism has been described in the set forth.

From the set forth descriptions, following matters will no doubt be apparent. Since the detecting arrangement for the ion-beam 5 comprises a horizontal line segment, for instance, a horizontal and sequential alignment of the plural detecting elements such as the Faraday tubes 6, the undesirable over-scanning to the external area to the circular shaped wafer 1 is always and securely detected at any vertical positions, or Y-positions of the wafer 1. The X-scanning width control feature makes a control of the width of the ion-beam X-scanning so as to correspond to the horizontal length at a level of the wafer 1 which is subjected to the ion-implantation. This permits preventing the over-scanning of the ion-beam 5 to the external and thus opposite area to the circular shaped wafer 1. Further, the Y-scanning speed control feature 8 makes a control the Y-scanning speed, and thus the speed of the vertical movement of the wafer thereby accomplishing a desirable ion-implantation to the wafer 1 having an uniformity in the dopant concentration.

Eventually, the novel scanning control feature involved in the parallel scanning type ion-implantation apparatus implements the self-controlled electrostatic X-scanning and mechanical Y-scanning. Actually, the prevention of the undesirable over-scanning to the external, or opposite area to the wafer 1 is able to provide a time reduction of 20 % to the ion-implantation as compared with the prior art.

Whereas modifications of the present invention will no doubt be apparent to a person of ordinary skilled in the art, it is to be understood that the embodiments shown and described by way of illustration are by no means intended to be considered in a limiting sense. Accordingly, it is to be intended by the claims to cover all modifications of the invention which fall within the sprit and scope of the invention.

Claims

1. A scanning control system for an ion-implantation apparatus employing mechanical scanning of an ion beam across a target in a first axis direction and ion-beam deflection scanning in a second axis direction orthogonal to the first axis, and having means (2) for mounting a target (1), said mounting means (2) being movable in the first axis direction to provide said mechanical scanning; characterised in that the scanning control system comprises means (6) locatable behind said mounting means for detecting over-scanning of the ion-beam (5), said detecting means (6) extending in the second axis direction over a length larger than the maximum dimension of said target (1) in the second axis direction; and means (4, 7) electrically connected to said detecting means (6) for controlling the scanning amplitude of the ion-beam in the second axis direction in response to over-scanning detected by the detecting means (6).

2. The scanning control system as claimed in Claim 1, wherein said scanning amplitude control means (4, 7) comprises a scanning amplitude controller (7) and deflection means (4), said scanning amplitude controller (7) being determinative of a frequency of scanning of the ion-beam (5) and supplying frequency control voltage signals to said deflection means (4).

3. The scanning control system as claimed in Claim 1 or Claim 2, further comprising means (3, 8) electrically connected to said scanning amplitude control means (7) and mechanically connected to said mounting means (2) for controlling the speed of scanning movement of said target in the first direction in response to said scanning amplitude controller (7).

4. The scanning control system as claimed in Claim 3, wherein said scanning speed control means (3, 8) comprises a scanning speed controller (8) arranged to supply electrical speed control signals to means for moving the mounting means in the first axis direction.

5. The scanning control system as claimed in any preceding claim, wherein said detecting means (6) comprises a plurality of detecting elements distributed over said length in the second axis direction.

6. The scanning control system as claimed in any preceding claim, wherein said detecting means (6) comprises a Faraday tube.

7. Ion implantation apparatus provided with a scanning control system as claimed in any preceding claim.

8. Apparatus as claimed in Claim 7, comprising means for deflecting the ion beam electrostatically in the second axis direction.

9. Apparatus as claimed in Claim 7 or 8, wherein said target mounting means (2) comprises a platen.

10. A scanning control system in an ion-implantation apparatus which accomplishes an electrostatic X-scanning and a mechanical Y-scanning, characterised in that said scanning control system comprises:

means (1) for mounting a wafer (1), said mounting means (2) being movable in a Y-direction;

means (6) located behind said wafer, mounting means (2) to receive an ion-beam and detect over-scanning of said ion-beam (5), said detecting means (6) comprising an X-wise extending line segment having a predetermined length larger than a diameter of said wafer (1); and

means (4, 7) electrically connected to said detecting means (6) for controlling an X-scanning width of ion-beam according to results of said over-scanning detection by said detecting means (6).

FIG.1 PRIOR ART

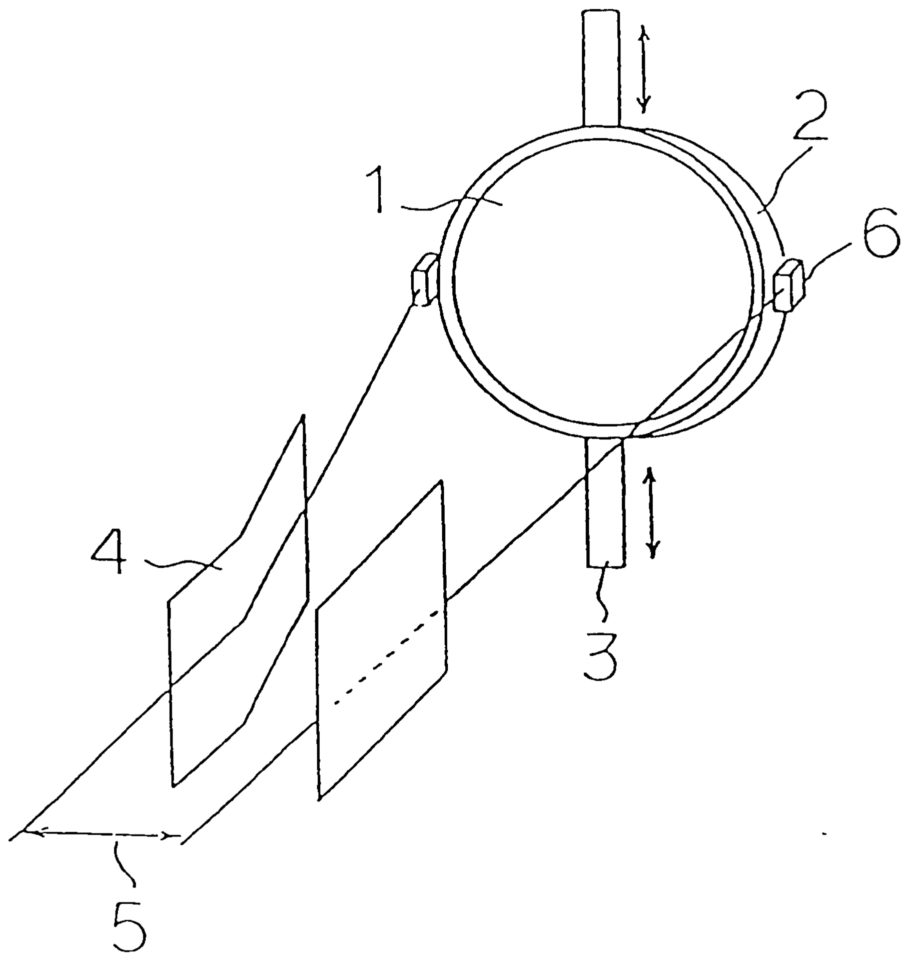
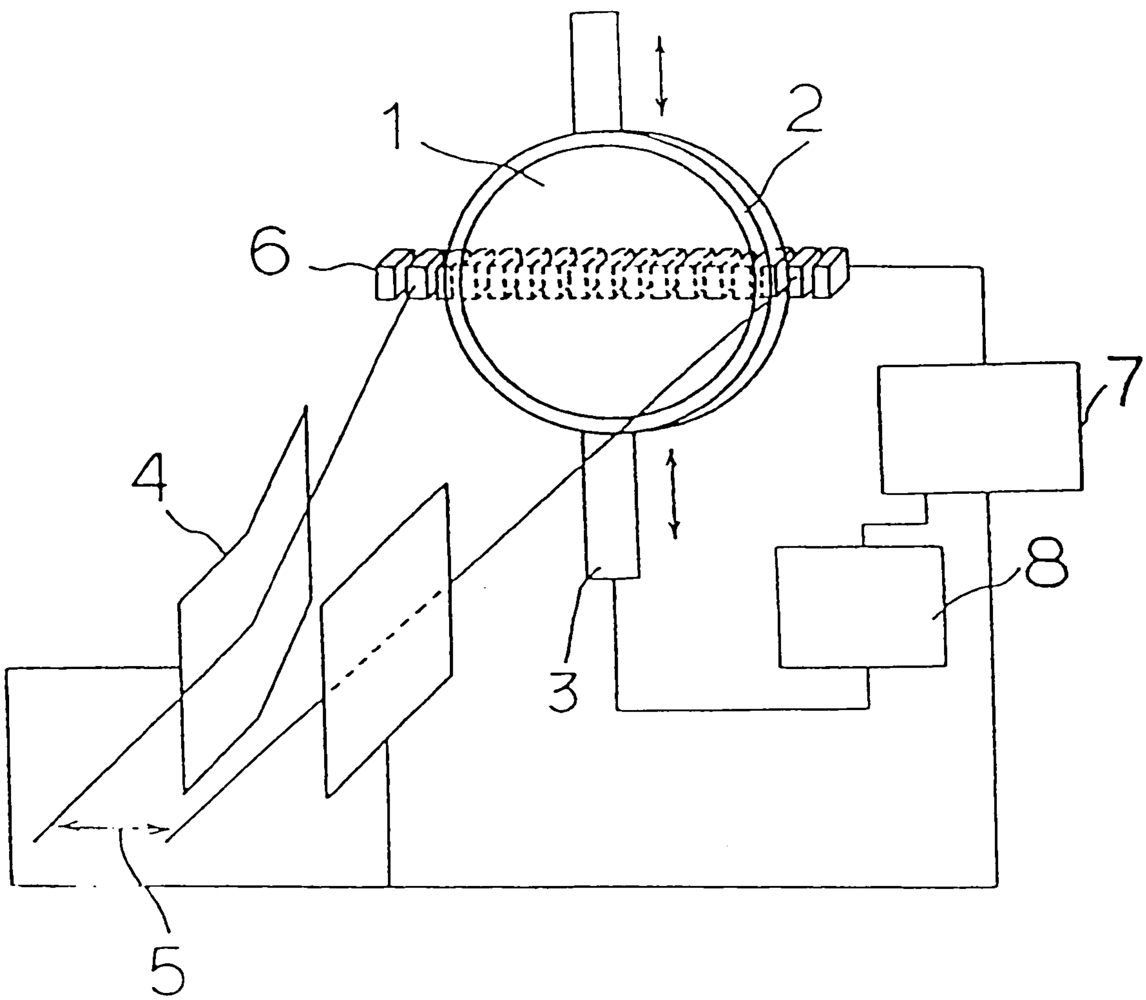


FIG.2



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EUROPEAN SEARCH REPORT

Application Number

EP 92 31 0370

DOCUMENTS CONSIDERED TO BE RELEVANT

Category	Citation of document with indication, where appropriate, of relevant passages	Relevant to claim	CLASSIFICATION OF THE APPLICATION (Int. Cl.5)
A	EP-A-0 431 757 (VARIAN) * abstract * * column 1, line 26 - column 2, line 5 * * column 20, line 47 - column 21, line 57 * * column 23, line 30 - column 24, line 48; figures 6,9,11-15 * ---	1-3,6-10	H01J37/244 H01J37/317
A	EP-A-0 398 270 (NISSIN ELECTRIC) * abstract * * column 1, line 9 - line 48; claims 1-2; figures 1,3 * ---	1,6-10	
A	WO-A-8 707 076 (VARIAN) * page 1, paragraph 1 * * page 6, line 22 - page 9, line 14; figures 1-3 * ---	1,8	
A	PATENT ABSTRACTS OF JAPAN vol. 14, no. 190 (E-918)18 April 1990 & JP-A-02 037 657 (FUJITSU) 7 February 1990 * abstract * -----	1	
			TECHNICAL FIELDS SEARCHED (Int. Cl.5)
			H01J

The present search report has been drawn up for all claims

Place of search	Date of completion of the search	Examiner
THE HAGUE	11 JANUARY 1993	GREISER N.

CATEGORY OF CITED DOCUMENTS

X : particularly relevant if taken alone
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